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**1981 VIRUS TOLERANCE RATINGS  
FOR CORN STRAINS  
Grown in the Lower Corn Belt.**

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In cooperation with  
Missouri Agricultural Experiment Station  
Ohio Agricultural Research and Development Center and  
Ohio Cooperative Extension Service

CORN

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## Preface

In continuing research to measure corn tolerance to natural virus infection by maize dwarf mosaic and maize chlorotic dwarf, breeders and researchers grew selected corn strains in test plots in lower parts of the Corn Belt. The results of these tests are given in this publication in two parts—corn strains grown in Missouri and those grown in Ohio.

Observers of the individual corn plants rated symptoms on a scale from 1 (no virus symptoms) to 9 (complete susceptibility). Infections varied in intensity between hybrids and inbreds. At all test locations, johnsongrass, an alternate host, was abundant near the plots. The rating variations within tests of inbreds and single cross and double cross hybrids are shown in tables in this publication.

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1981 Virus Tolerance Ratings of Corn Strains Grown in Missouri<sup>1</sup>

100 J. R. Wallin, D. V. Loonan, and C. A. C. Gardner<sup>2</sup>

We evaluated and identified corn (*Zea mays* L.) strains in 1981 that exhibit tolerance to maize dwarf mosaic virus (MDMV) and maize chlorotic dwarf virus (MCDV). Results of our evaluation will be useful to corn growers and commercial hybrid seed corn producers for identifying hybrids with high levels of tolerance that are to be planted in areas of high virus incidence.

Commercial corn varieties were grown at two locations in Missouri where MDMV and MCDV symptoms were observed under conditions of natural infection. Test plots were located on the Bonacker Farm near House Springs, Jefferson County, and on the Delta Research Center, Portageville, Pemiscot County. In addition, 34 North Central Region inbred lines, 13 PR-Mo2 selections, 110 ear-rows of PR-Mo2, and 100 ear-rows of BS13 were planted at House Springs.

Planting was delayed at House Springs until June 10 and at Portageville until May 22 because of adverse weather conditions and to obtain high levels of virus infection from johnsongrass (*Sorghum halpense* (L) Pers.), the alternate host for the corn viruses involved where Johnsongrass was abundant and grew to about 2 m high in and around the test plots at both locations. The corn genotypes to be evaluated were planted with a four-row plot planter in single row replicated plots 6.4 m long, consisting of 28 plants; rows were spaced 91 cm apart.

### Virus incidence

MDMV and MCDV were identified by plant symptoms at House Springs. For the second successive year, no virus symptoms were observed

at Portageville. We attributed this to the sanitary practices of the Delta Research Center in successfully controlling johnsongrass. The plant was not found in or around the experimental plots.

MDMV produces a typical mosaic pattern, whereas MCDV produces vein clearing of infected leaves. The corn leaf aphid, *Rhopalosiphum maidis* (Fitch), the greenbug, *Schizaphus graminum* (Ron-dani), and several other aphids are vectors for MDMV, which can also be transmitted mechanically. The leafhopper, *Graminella nigrifrons* (Forbes), is the vector of MCDV, which cannot be mechanically transmitted.

We rated each plant within a plot for virus symptoms on a 1 to 9 severity scale, where 1 represented no symptoms and 9 represented death of the plant. The ratings were made only for severity and not for specific types of virus. The North Central Region inbred lines were rated at about 91 cm height and at maturity since MDMV symptoms were more easily detected in the early stage. Plot means were used in further analyses. At House Springs in 1981, the average virus rating for the tolerant single cross, Mo14W × Oh7B (14-year average = 3.05) was 2.10. This was 8 percent lower than in 1980. The susceptible cross, Mo5 × H55, (14-year average = 6.84) rated 2.93 or 49 percent lower than in 1980. These check hybrids were also planted at the Delta Research Center for the 14th consecutive year, but no virus symptoms were observed.

### Commercial hybrids

Virus ratings were made for 3 replications of 32 commercial and 2 check hybrids at House Springs (table 1). The lowest rating was 1.62, and 2.93 was the highest. Virus infections were considerably lower than in 1980. In 1980, only 19 hybrids rated 2.50 or less, while 28 rated 2.50 or less in 1981. These data indicated that environmental factors were less favorable for virus development in 1981 than in 1980 and, perhaps, there was a lower population of vectors in the plots. Most hybrids

<sup>1</sup> Cooperative investigations between the U.S. Department of Agriculture, Agricultural Research Service, and the University of Missouri Agricultural Experiment Station, Columbia, Mo. 65211, Journal Series No. 8875.

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could not be statistically differentiated at this level of incidence.

**Table 1.—1981 virus ratings for 32 commercial and 2 check hybrids grown at House Springs, Jefferson County, Mo., planted June 10, rated August 20, 1981**

Entry	Rating <sup>1</sup>	DMRT <sup>2</sup>
DeKalb XL72B	1.62	a
Pioneer Brand 3328	1.75	a-b
Pioneer Brand 3147	1.77	a-c
McCurdy 77-28	1.80	a-c
Northrup King PX79	1.81	a-c
Pfizer Genetics EXP44576	1.82	a-d
Funks G-4740	1.83	a-d
Pioneer Brand 3160	1.85	a-d
Northrup King PX95	1.87	a-d
Golden Harvest XC160	1.87	a-d
P-A-G SX17A	1.88	a-d
Funks G-4525A	1.91	a-e
NC+ 5820	1.92	a-e
McCurdy 8225	1.94	a-e
Asgrow H796150	1.94	a-e
DeKalb XL72BB	1.97	a-d
McCurdy 7978	2.07	a-e
Mo14W X Oh7b <sup>3</sup>	2.10	a-e
O's Gold 5255	2.13	a-e
NC+ 5775	2.13	a-e
Golden Harvest H2660W	2.15	a-f
O's Gold 3344	2.19	a-f
Golden Harvest XC165	2.21	a-f
DeKalb XL394	2.22	a-f
Cargill 951	2.25	a-f
P-A-G Exp 284074	2.27	a-f
Pioneer Brand X7509	2.32	a-f
Golden Harvest H2745	2.38	a-f
Pfizer Genetics MDM116	2.41	a-f
Asgrow RX962W	2.54	b-f
McCurdy 7751	2.56	c-f
Northrup King EXP064720	2.61	d-f
Northrup King EXP064504	2.68	e-f
Mo5 X H55 <sup>3</sup>	2.93	f
Mean rating		2.11
Least significant difference, $P = 0.05$		0.18
Coefficient of variation		18.8%

<sup>1</sup> Rating scales 1-9, 1 = no symptoms; 9 = dead plant.

<sup>2</sup> Duncan's Multiple Range Test—Entries with the same letter in common are not significantly different at the 5 percent probability level.

<sup>3</sup> Check hybrids.

#### NCR-2 uniform inbred evaluation

Virus ratings were made for 2 replications of the 34 North Central Region inbred lines grown at

House Springs (table 2). The ratings ranged from

**Table 2.—1981 first virus ratings for 34 North Central Region inbred lines grown at House Springs, Mo., planted June 10, rated July 30, 1981**

Entry	Rating <sup>1</sup>	DMRT <sup>2</sup>
Mich 80-2	2.00	a
A 77-3	2.84	a-b
A 77-7	3.30	a-c
Pa 77-34	3.43	a-d
A 77-8	3.62	a-e
Oh 43	3.75	b-f
Oh 91653	3.79	b-f
Pa 73-13	3.85	b-f
Oh 7B	3.88	b-f
Mich 80-1	3.91	b-f
Pa 73-11	4.00	b-f
Pa 77-49	4.12	b-f
ND 78-1	4.21	b-g
Pa 74-4	4.37	b-g
W 117	4.40	b-g
Oh 91624	4.45	b-h
Pa 74-2	4.50	b-h
Mich 80-4	4.65	c-h
W 64A	4.66	c-h
B 73	4.83	c-i
W 153R	5.07	c-i
Mo 17	5.16	d-j
Mich 79-4	5.19	d-j
Pa 74-7	5.21	d-j
Pa 73-18	5.22	d-j
Mich 79-1	5.24	d-j
ND 77-2	5.38	e-j
Pa 77-58	5.38	e-j
ND 78-2	5.49	f-j
Oh 91610	6.00	g-j
ND 78-3	6.20	h-j
Pa 73-17	6.57	i-j
ND 78-6	6.86	j
Mich 80-3	6.87	j
Mean rating		4.66
Least significant dif., $P = 0.05$		0.34
Coefficient of variation		15.8%

<sup>1</sup> Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = collapsed to dead plant.

<sup>2</sup> Duncan's Multiple Range Test—Entries with the same letter in common are not significantly different at the 5 percent probability level.



2.00 to 6.87 for the first rating date (July 30). The rating range for the second rating date (August 20) was from 3.08 to 8.25 (table 3). Generally, the vi-

rus symptoms were more severe by August 20. The combined influence of MDM and MCD would be expressed by the later date.

**Table 3.—1981 second virus rating for North Central Region inbred lines on August 20, 1981**

Entry	Rating <sup>1</sup>	DMRT <sup>2</sup>
Oh 91653	3.08	a
Oh 7B	3.54	a-b
Oh 91624	3.99	a-c
Pa 77-34	4.30	a-d
Mich 80-2	4.54	a-e
Pa 74-4	5.04	a-f
Pa 74-2	5.12	b-f
Oh 43	5.44	b-g
Pa 73-11	5.50	b-h
A 77-3	5.50	b-h
W 117	5.60	b-h
Mich 79-4	5.63	c-h
Pa 73-13	5.68	c-h
ND 78-1	5.79	c-i
Mich 80-1	5.88	c-j
Pa 77-49	5.90	c-j
Mo 17	6.07	c-j
ND 18-6	6.09	c-j
Pa 73-18	6.19	d-k
A 77-8	6.21	d-k
A 77-7	6.64	e-k
ND 78-3	6.84	f-k
W 153R	7.00	f-k
Mich 80-4	7.04	f-k
B 73	7.08	f-k
W 64A	7.29	g-k
Pa 74-7	7.32	g-k
Mich 79-1	7.33	g-k
Pa 77-58	7.48	g-k
Oh 91610	7.57	g-k
ND 78-2	7.63	h-k
Mich 80-3	7.82	i-k
Pa 73-17	7.97	j-k
ND 77-2	8.25	k
Mean rating	6.13	
Least significant dif., P = 0.05	0.42	
Coefficient of variation	14.2%	

<sup>1</sup> Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = collapsed to dead plant.

<sup>2</sup> Duncan's Multiple Range Test—Entries with the same letter in common are not significantly different at the 5 percent probability level.

### Evaluations of recurrent selection populations

Two replications of 13 original and selected populations were planted June 10 and rated August 20 at House Springs (table 4). Generally, all populations had low ratings (range from 1.53 to 2.50). The same 13 populations were planted in Columbia and artificially inoculated with MDMV and rated August 19 (table 4). Again, all 13 rated low virus injury. In this test, the populations were subjected to only one virus, while at House Springs, they were subjected to natural infection with the two viruses. Even the unselected populations expressed excellent resistance to the two viruses. The combined analysis of data from 1979, 1980, and 1981 showed years and entries to be significant, but year  $\times$  entry interactions were not significant. Although this indicated no progress from selection, the ratings were all low, indicating good virus resistance in the material.

**Table 4.—Analysis of progress from selection in 4 populations grown and inoculated in Rollins' Bottom, Columbia, Mo. (planted April 17, rated August 19, 1981) and grown at House Springs, Mo., under conditions of natural infection<sup>1</sup> (planted June 10, rated August 20, 1981)**

Population	Cycle	Rating	
		House Springs <sup>1</sup>	Rollins Bottom <sup>1</sup>
PR-Mo2 (S1) <sup>2</sup>	0	3.14	1.45
	1	2.20	1.97
	2	3.01	3.12
	3	1.77	1.95
		$b_1 = -0.33^3$	$b_1 = 0.27^3$
		$r^2 = 0.27^4$	$r^2 = 0.23$
PR-Mo2 (M) <sup>2</sup>	0	3.14	1.45
	1	2.32	1.58
	2	2.02	1.80
	3	2.62	1.91
		$b_1 = -0.19^3$	$b_1 = 0.16^3$
		$r^2 = 0.25^4$	$r^2 = 0.98^4$

<sup>1</sup> House Springs data are combined analysis of data from 1979, 1980, and 1981. Rollins' Bottom data are 1981 only. Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = collapsed to dead plant.

<sup>2</sup> Type of selection: M = mass, S1 = S<sub>1</sub> progeny.

<sup>3</sup> Nonsignificant at the 5 percent probability level.

<sup>4</sup>  $r^2$  calculated from all rep data.

### Virus ratings of 110 ear-rows of PR-Mo2

Two replications of 110 ears of PR-Mo2 were planted ear-to-row on June 10 at House Springs and rated August 20 (table 5). These plants sustained more virus injury than the recurrent selection populations. The 110 entries were rated from 2.71, the least injured, to 5.95, the greatest injured, while none of the three cycles of PR-Mo2 selection rated greater than 3.01 for the naturally infested selections and 3.12 for the artificially inoculated selections. The calculated heritability was 0.86, and predicted gain per cycle was 0.43.

**Table 5.—Analysis of predicted gain per cycle for ear-to-row selection in PR-Mo2 and BS13 planted June 10, rated August 20, 1981, at House Springs, Mo.**

	PR-Mo2	BS13
No. ear-rows	110	100
Mean rating	4.08	3.41
Range	2.71-4.16	1.67-3.80
CV%	18.2	25.6
$\sigma^2_G$	3.28	0.36
$\sigma^2_P$	3.83	1.11
Heritability	0.86	0.32
Selection differential	1.01	1.49
Predicted gain per cycle <sup>1</sup>	0.43	0.24

<sup>1</sup> Assuming ear-to-row selection, recombining remnant seed.

### Virus ratings of 100 ear-rows of BS13

Two replications of 100 ears of BS13 planted ear-to-row were rated August 20 (table 5). The individual ear-rows rated from 1.67 to 5.32, slightly better or more resistant than the ear-rows of PR-Mo2. Heritability was calculated to be 0.32, and the predicted gain per cycle to be 0.24.

### Conclusions

Virus symptoms and the infection levels were less severe in the commercial hybrids in 1981 than in 1980 and about the same for the North Central Region inbred lines. Again, as in 1980, the Portageville test site did not have adequate johnsongrass for virus inoculum, so no results were obtained.

The PR-Mo2 cycles of selection seemed to offer sources of resistance to MDMV and MCDV and

will be placed in trials in 1982 although progress from selection was statistically insignificant in 1981. Most of these entries proved highly resistant when artificially inoculated with MDMV in the Columbia plots.

Seed from 10 selected ears of BS13 and PR-Mo2 that had the lowest virus injury ratings from the ear-to-row studies at House Springs were random mated in a Hawaiian winter nursery to complete the cycle of selection.

A potential virus threat exists wherever johnsongrass grows; therefore, corn growers should select hybrids with the highest levels of virus tolerance. Many of the commercial hybrids tested in 1981 had tolerance levels that should be considered adequate for planting in virus problem areas.



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**Virus Tolerance Ratings of Corn Strains Grown in Ohio in 1981<sup>1</sup>**

100 William R. Findley, Raymond Louie, and John K. Knoke<sup>2</sup>

Inbred lines and hybrids grown in the Ohio river valley near Portsmouth on the farm of James Daulton were rated for virus disease incidence resulting from natural infection.

Inbred line tests were sponsored by the Ohio Agricultural Research and Development Center (OARDC), the North Central Corn Breeding Research Committee (NCCBRC), and the Interregional Corn Conference. A hybrid test was conducted cooperatively with OARDC and the Ohio Cooperative Extension Service.

We planted seeds of the corn strains mechanically in replicated plots on June 15 and 16, 1981. Plots were 16.5 ft (5 m) long in rows 3 ft (91 cm) apart and separated by 4-ft (122 cm) aisles between tiers of plots. Twenty five seeds of each inbred were planted in one-row plots. Seeds of the hybrids were planted in two-row plots, 60 seeds per row, and later thinned to 34 plants per row. Inbreds were grown in two replications; hybrids in four replications.

Stands of most inbred entries were satisfactory but generally reduced 20 to 40 percent by wet soil conditions at planting time. All hybrid entries had adequate stands. Within a few hours following completion of planting, a heavy rain fell on soil that was only marginal for dryness when planting began. Throughout the growing season, rainfall was received in limited amounts and temperatures averaged below normal. Essentially no rain fell during the last 3 weeks in August.

### **Virus incidence**

Incidence of maize dwarf mosaic virus (MDMV) in trap plants (WF9xOh51A seedlings exposed for 7-day periods throughout the growing season) exceeded the 50 percent level by June 30 and averaged above the 90 percent level from August 4 to September 9. Incidence of maize chlorotic dwarf virus (MCDV) in these same trap plants averaged over the growing season only 3 percent. A disease peak of 10 percent occurred the week ending August 11.

Virus disease incidence in 1979, 1980, and 1981 seasons in 28 inbred lines averaged 49, 7, and 23 percent for MDM; 77, 18, and 37 percent for MCD; and 5.4, 3.6, and 4.1 for virus disease ratings, respectively. In 21 hybrids common to the 1979, 1980, and 1981 seasons, MDM averaged 9, 2, and 7 percent; MCD 27, 3, and 4 percent; and virus disease ratings 2.2, 1.9, and 2.5, respectively.

### **Virus disease ratings**

We observed plants for symptoms of MDM and MCD and rated them for reaction to virus infection. Symptoms of MDM and MCD on individual plants were observed on August 11 or 12. Symptoms of MDM were chlorotic patterns of mosaic, rings, flecks, streaks, or mottle. The diagnostic symptom of MCD was a chlorotic streaking in the smallest leaf veins.

Inbred lines were rated on August 11, except those in the OARDC test and 1100-1200 maturity interregional test, which were rated on August 26. Hybrids were rated on August 25. Ratings relate to reaction of corn strains to the virus disease complex. We rated each entry on a plot basis. Plants rated 2 were faintly chlorotic and those rated 3 were distinctly chlorotic. The virus rating scale that included degrees of stunting was not asso-

<sup>1</sup> Cooperative investigation of the U.S. Department of Agriculture, Agricultural Research Service, Ohio Agricultural Research and Development Center, Wooster, Ohio 44691, and the Ohio Cooperative Extension Service, Columbus, Ohio 43210.

<sup>2</sup> Findley is a research agronomist; Louie, a research plant pathologist; and Knoke, a research entomologist, USDA, ARS, Wooster, Ohio 44691.

ciated with ratings of 3 or less. Ratings of 4 to 9 indicated increasing degrees of stunting and chlorosis and reduction in ear size.

Any combination of mean comparisons are possible with Duncan's New Multiple Range Test (DNMRT). Entries that do not have the same letter in common differ at the 5 percent probability level. We computed least significant difference (LSD) at the 5 percent probability level and also coefficient of variation (CV) values. The LSD is useful in comparing means with a common standard or adjacent means. The CV indicates test uniformity: the lower the CV, the greater the degree of test uniformity.

### Inbred evaluation

Percentage of plants with MDM and MCD and mean plot virus disease ratings of the 50 inbred lines in the OARDC test are shown in tables 6, 7, and 8, respectively. Experimental variation resulted in, according to DNMRT, statistically equal resistant reaction of inbreds ranging from 0 to 36.1 percent MDM, 0 to 47 percent MCD, and 1.0 to 4.0 virus disease rating.

Thirty-four experimental inbred lines, excluding checks, were included in the NCCBRC test. Percentages of MDMV- and MCDV-infected plants and mean plot virus disease ratings are reported in tables 9, 10, and 11, respectively. The inbreds were not significantly different in percentage MCDV-infected plants. Inbreds ranging from 0 to 71.6 percent MDMV-infected plants and 2.5 to 4.0 in virus disease rating were equally resistant at the 5 percent probability level according to DNMRT.

Interregional tests included inbred lines in maturity groups 100-300 shown in tables 12 through 14, 900-1000 in tables 15 and 16, and 1100 to 1200 in tables 17 through 19. Of the 33 inbreds of 100-300 maturity, statistically significant mean differences at the 5 percent probability level were found for percentages of MDMV-infected plants and virus disease ratings. Respective ranges for equally resistant reactions were 0 to 55.6 percent and 3.5 to 6.0 percent. The 15 inbred lines of 900-1000 maturity were found to be statistically different in percentage MCDV-infected plants, with an equally resistant range of 0 to 20.3 percent. The most susceptible line in this group had only 38.5 percent MCDV-infected plants. The nine lines of 1100-1200 maturity were not statistically different

in the three traits studied.

### Hybrid evaluation

Results of the hybrid test are reported in tables 20, 21, and 22 for percentages of MDMV- and

**Table 6.—Incidence of maize dwarf mosaic (MDM) in inbred lines in the Ohio Agricultural Research and Development Center test, August 12, 1981, Portsmouth, Ohio**

Inbred	MDM-Percent
Oh91634	0 a <sup>1/</sup>
Oh5145	0 a
T240	0 a
B68	0 a
Oh509	0 a
Pa405 <sup>2/</sup> x Zea dip.	0 a
T143	0 a
GT3	0 a
Oh570	0 a
GA203	0 a
CG1	0 a
GA209	0 a
Pa405	0 a
H95	0 a
Ky61-2335	0 a
Oh513	0 a
Oh514	0 a
N7B	0 a
Pa32	0 a
Mo20W	0 a
Oh91653	2.4 a
T232	2.8 a
N6J	3.1 a
Ky66-2500	3.1 a
Oh572	3.3 a
Tx601	3.3 a
Oh7B	3.3 a
Oh07	3.6 a
B54	6.3 a
JSA52-2	8.3 a
B64	10.0 a
Oh91619	10.5 a
Mo12	25.6 ab
Pa884P	36.1 a-c
B37	43.6 b-d
E14-2-9	44.3 b-d
K61-1	44.4 b-d
Va35	51.1 b-d
CI.38B	52.5 b-d
Oh45B	54.7 b-e
M14	59.0 b-f
Ky226	60.8 c-f
Oh509A	66.3 c-f
Mo17	67.6 c-f
Mo5	71.7 d-f
Oh517	73.5 d-f
C103	73.6 d-f
Oh545	88.9 ef
OhNS1-#10/-S-S-#-S1-11-S	90.6 f
Oh43	91.6 f
Coefficient of variation	63.9%
Least significant difference	29.9
Mean percent	23.1

<sup>1/</sup>Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

MCDV-infected plants and mean plot virus disease ratings, respectively. We included 47 proprietary and 11 open-pedigree combinations. Statistically, 51, 50, and 43 hybrids were equally

good in percentage of MDMV- and MCDV-infected plants and virus disease ratings, respectively.

**Table 7.—Incidence of maize chlorotic dwarf (MCD) in inbred lines in the Ohio Agricultural Research and Development Center test, August 12, 1981, Portsmouth, Ohio**

Inbred	MCD-Percent
Oh513	0 a1/
Oh91634	2.2 a
Oh07	3.6 a
Oh570	5.8 a
N6J	6.3 ab
T143	7.1 a-c
T240	7.1 a-c
Oh7B	9.4 a-c
GA209	11.1 a-c
Oh509	11.9 a-d
Oh572	12.4 a-d
B68	13.2 a-d
JSA52-2	13.9 a-d
Oh5145	14.7 a-d
Mo20W	16.7 a-d
Pa884P	16.7 a-d
Mo12	16.7 a-d
T232	18.1 a-e
Tx601	20.3 a-f
Oh91653	21.9 a-g
K61-1	22.2 a-g
N7B	26.7 a-h
Pa4052/xZea dip.	26.8 a-h
Ky66-2500	28.1 a-h
GT3	28.9 a-h
Oh517	29.2 a-h
H95	30.0 a-h
B64	30.0 a-h
Oh514	31.6 a-h
CG1	31.7 a-h
Oh509A	32.8 a-h
C103	34.6 a-h
Mo17	41.1 a-i
Oh91619	42.1 a-i
Ky61-2335	47.0 a-i
Pa405	55.8 b-j
B54	56.3 c-j
M14	60.7 d-j
Oh545	61.1 d-j
E14-2-9	66.2 e-j
OhNS1-#10/-S-S-#-S1-11-S	66.5 e-j
Oh43	69.6 f-j
CI. 38B	70.0 g-j
Ky226	71.9 h-j
B37	72.3 h-j
Mo5	84.6 ij
Oh45B	85.3 ij
Pa32	85.7 ij
GA203	86.4 ij
Va35	100.0 j
Coefficient of variation	56.0%
Least significant difference	40.8
Mean percent	36.1

<sup>1</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 8.—Virus disease ratings on inbred lines in the Ohio Agricultural Research and Development Center test, August 26, 1981, Portsmouth, Ohio**

Inbred	Virus disease rating <sup>1/</sup>
Oh513	1.0 a2/
Oh91634	1.5 ab
T240	2.0 a-c
Oh570	2.0 a-c
GA209	2.5 a-d
Mo20W	2.5 a-d
Oh509	2.5 a-d
Oh07	2.5 a-d
Oh5145	2.5 a-d
H95	2.5 a-d
T143	2.5 a-d
JSA52-2	3.0 a-e
Oh514	3.0 a-e
B68	3.0 a-e
N6J	3.0 a-e
Ky66-2500	3.0 a-e
Oh7B	3.0 a-e
Ky61-2335	3.5 a-f
N7B	3.5 a-f
T232	3.5 a-f
Mo12	3.5 a-f
K61-1	3.5 a-f
Oh572	3.5 a-f
Pa884P	4.0 a-g
GA203	4.0 a-g
Tx601	4.0 a-g
Pa4052/xZea dip.	4.0 a-g
B54	4.0 a-g
GT3	4.5 b-h
Oh91653	4.5 b-h
CG1	5.0 c-h
C103	5.0 c-h
Pa405	5.0 c-h
Oh517	5.0 c-h
Oh91619	5.5 d-h
B64	5.5 d-h
Mo17	5.5 d-h
Oh509A	5.5 d-h
Ky226	5.5 d-h
Pa32	5.5 d-h
CI. 38B	6.0 e-h
Va35	6.0 e-h
B37	6.0 e-h
Oh545	6.5 f-h
OhNS1-#10/-S-S-#-S1-11-S	7.0 gh
Mo5	7.0 gh
M14	7.0 gh
Oh45B	7.0 gh
E14-2-9	7.5 h
Oh43	7.5 h
Coefficient of variation	30.0%
Least significant difference	2.6
Mean percent	4.3

<sup>1</sup> Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = severe symptoms.

<sup>2</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.



## Conclusions

Incidence and distribution of virus diseases over the test area contributed to large error terms in the statistical analyses; hence, ranges of values of equally good disease reactions were large. Such wide ranges of statistically equal values make interpretations of the results difficult. Strains with high percentages of infected plants and high virus disease ratings were probably not as tolerant as strains with low readings.

**Table 9.—Incidence of maize dwarf mosaic (MDM) in inbred lines in the North Central Corn Breeding Research Committee uniform test, August 12, 1980, Portsmouth, Ohio**

Inbred	MDM-Percent	
Pa73-13	0	a <sup>1/</sup>
Oh7B	0	a
Oh91653	0	a
Pa74-4	0	a
Pa74-2	8.8	ab
Pa77-49	17.0	ab
Mich.79-1	19.2	ab
A77-8	23.8	a-c
Pa73-11	26.9	a-d
ND78-1	30.0	a-d
A77-3	31.7	a-d
A77-7	33.3	a-d
ND78-6	33.7	a-d
Pa77-58	39.5	a-d
W64A	39.8	a-d
W153R	46.3	a-d
Pa73-17	46.4	a-d
W117	50.0	a-d
Mich.80-1	50.0	a-d
Mich.80-2	57.1	a-d
Mo17	62.0	a-d
Pa74-7	65.0	a-d
Oh91610	66.6	a-d
Oh91624	68.5	a-d
Pa77-34	71.6	a-d
Mich.79-4	74.4	b-d
ND78-2	74.5	b-d
ND78-3	75.0	b-d
Pa73-18	79.6	b-d
B73	79.9	b-d
Mich.80-3	80.4	b-d
Oh43	96.9	cd
Mich.80-4	97.6	cd
ND77-2	100.0	d
Coefficient of variation	62.6%	
Least significant difference	61.9	
Mean percent	48.4	

**Table 10.—Incidence of maize chlorotic dwarf (MCD) in inbred lines in the North Central Corn Breeding Research Committee uniform test, August 12, 1981, Portsmouth, Ohio**

Inbred	MCD-Percent
Oh7B	0
Oh91653	5.0
W117	14.9
ND78-1	19.2
Pa77-34	21.6
A77-7	25.6
Pa74-4	28.1
A77-3	40.5
Pa73-17	40.7
Pa77-49	44.2
W153R	49.6
W64A	50.9
Oh43	52.1
Mich.80-2	52.1
ND78-2	53.7
Mo17	54.7
Pa73-13	54.7
A77-8	58.1
Pa77-58	58.4
Mich.79-1	61.5
ND78-6	67.4
Pa74-7	67.5
Pa73-11	69.2
Oh91624	73.3
ND77-2	75.0
ND78-3	75.0
Mich.80-3	75.0
Mich.80-4	75.8
B73	76.6
Pa74-2	77.0
Mich.80-1	85.7
Mich.79-4	87.8
Pa73-18	94.1
Oh91610	97.5
Coefficient of variation	52.2%
Least significant difference	N.S.
Mean percent	55.4

<sup>1</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 11.—Virus disease ratings on inbred lines in the North Central Corn Breeding Research Committee uniform test, August 11, 1981, Portsmouth, Ohio**

Inbred	Virus disease rating <sup>1/</sup>	
Oh91653	2.5	a <sup>2/</sup>
Oh7B	2.5	a
Pa77-34	4.0	ab
ND78-1	4.0	ab
Pa74-4	4.0	ab
Pa74-2	4.0	ab
W117	4.0	ab
Pa73-13	4.0	ab
ND78-2	4.0	ab
A77-8	4.5	bc
Pa74-7	4.5	bc
Mich.80-2	4.5	bc
Pa.73-17	4.5	bc
Pa.77-49	4.5	bc
Pa.73-11	5.0	b-d
A77-7	5.0	b-d
Oh43	5.5	b-e
W153R	5.5	b-e
Mich.79-1	5.5	b-e
W64A	5.5	b-e
B73	5.5	b-e
Mo17	6.0	c-f
ND77-2	6.0	c-f
A77-3	6.0	c-f
Mich.79-4	6.5	d-f
Oh91624	6.5	d-f
Oh91610	6.5	d-f
Pa73-18	6.5	d-f
Mich.80-4	6.5	d-f
Mich.80-3	6.5	d-f
Pa77-58	7.0	ef
Mich.80-1	7.0	ef
ND78-6	7.0	ef
ND78-3	7.5	f
Coefficient of variation	13.8	
Least significant difference	1.5	
Mean rating	5.3	

<sup>1</sup> Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = severe symptoms.

<sup>2</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 12.—Incidence of maize dwarf mosaic (MDM) in inbred lines of 100-300 maturity in Interregional Maize Inbred Evaluation test, August 12, 1981, Portsmouth, Ohio**

Inbred	MDM-Percent	
ND376	0	a <sup>1/</sup>
A665	0	a
Pa373	0	a
A666	8.1	ab
CM105	11.2	a-c
CL1	12.5	a-c
CG13	16.7	a-d
Pa329	17.1	a-d
Pa374	25.0	a-e
A671	29.4	a-e
ND246	34.4	a-f
CG14	35.0	a-f
Pa326	35.0	a-f
CG15	41.4	a-g
ND100	45.0	a-h
CK69	45.6	a-h
ND301	50.0	a-h
CO109	52.3	a-h
CG12	55.6	a-h
ND300	60.4	b-h
CG17	62.5	b-h
CG11	63.9	b-h
ND241	65.2	c-h
CK52	66.7	c-h
CG18	70.6	d-h
ND245	70.6	d-h
ND240	72.4	d-h
A661	78.6	e-h
CG16	80.0	e-h
CK64	86.7	f-h
CK75	90.6	f-h
ND408	96.4	gh
ND474	100.0	h
Coefficient of variation	48.0%	
Least significant difference	47.0	
Mean percent	47.8	

<sup>1</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.



Table 13.—Incidence of maize chlorotic dwarf (MCD) in inbred lines of 100-300 maturity in Interregional Maize Inbred Evaluation test, August 12, 1981, Portsmouth, Ohio

Inbred	MCD-Percent
ND376	24.6
CG13	26.2
ND245	39.4
A665	40.0
ND301	42.8
ND240	44.3
CG14	44.4
CM105	46.1
CL1	48.2
Pa329	53.0
CO109	55.5
CG12	55.6
CK69	56.2
CG15	56.4
ND100	57.5
A666	58.1
ND246	59.4
A671	60.0
CG11	69.4
ND408	71.4
Pa326	72.5
Pa373	75.0
A661	77.4
CK64	80.0
ND241	81.3
CK52	83.3
Pa374	87.5
CG17	92.4
ND300	93.8
ND474	96.4
CK75	100.0
CG16	100.0
CG18	100.0
Coefficient of variation	44.2%
Least significant difference	N.S.
Mean percent	65.1

Table 14.—Virus disease ratings on inbred lines of 100-300 maturity in Interregional Maize Inbred Evaluation test, August 11, 1981, Portsmouth, Ohio

Inbred	Virus disease rating <sup>1/</sup>
ND376	3.5 a <sup>2/</sup>
Pa329	4.0 a
CG14	4.0 a
ND245	4.5 ab
Pa374	4.5 ab
ND241	4.5 ab
ND240	4.5 ab
CG15	4.5 ab
ND246	4.5 ab
A661	5.0 a-c
A671	5.0 a-c
A666	5.0 a-c
ND301	5.0 a-c
A665	5.0 a-c
Pa373	5.0 a-c
CL1	5.5 a-d
ND300	5.5 a-d
CG17	5.5 a-d
Pa326	5.5 a-d
CG13	5.5 a-d
CG12	5.5 a-d
CM105	5.5 a-d
CO109	5.5 a-d
CK69	5.5 a-d
CK64	5.5 a-d
ND100	6.0 a-d
CK52	6.0 a-d
CG11	6.0 a-d
CG18	7.0 b-d
CG16	7.0 b-d
ND474	7.0 b-d
ND408	7.5 cd
CK75	8.0 d
Coefficient of variation	19.0%
Least significant difference	2.1
Mean rating	5.4

<sup>1</sup> Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = severe symptoms.

<sup>2</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 15.—Incidence of maize dwarf mosaic (MDM) in inbred lines of 900-1000 maturity in Interregional Maize Inbred Evaluation test, August 12, 1981, Portsmouth, Ohio**

Inbred	MDM -Percent
FR802W	0
T147	0
T258	0
T155	2.6
GA209	2.9
T151	2.9
FR805W	3.6
T250	5.9
T159	6.3
T256	12.0
T145	22.2
T153	23.1
Mo17	43.8
CI.66	59.7
T254	66.7
Coefficient of variation	137.5%
Least significant difference	N.S.
Mean percent	16.8

**Table 16.—Incidence of maize chlorotic dwarf (MCD) in inbred lines of 900-1000 maturity in Interregional Maize Inbred Evaluation test, August 12, 1981, Portsmouth, Ohio**

Inbred	MCD-Percent
T159	0 a <sup>1/</sup>
T151	0 a
T254	0 a
CI.66	0 a
T250	2.8 ab
T147	4.8 ab
FR802W	6.7 a-c
FR805W	7.9 a-c
T145	10.8 a-c
GA209	14.1 a-c
T155	15.8 a-c
T256	20.3 a-d
T258	21.6 b-d
Mo17	26.7 cd
T153	38.5 d
Coefficient of variation	74.4%
Least significant difference	18.0
Mean percent	11.3

<sup>1</sup>Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 17.—Incidence of maize dwarf mosaic (MDM) in inbred lines of 1100-1200 maturity in Interregional Maize Inbred Evaluation test, August 12, 1981, Portsmouth, Ohio**

Inbred	MDM-Percent
SC76	4.8
T232	13.9
NC248	19.0
SC55	21.4
SC43	24.3
NC246	32.5
SC213	34.0
SC12	46.0
GT112RF	66.0
Coefficient of variation	96.4%
Least significance difference	N.S.
Mean percent	29.1

**Table 18.—Incidence of maize chlorotic dwarf (MCD) in inbred lines of 1100-1200 maturity in Interregional Maize Inbred Evaluation test, August 12, 1981, Portsmouth, Ohio**

Inbred	MCD-Percent
T232	0
GT112RF	0
SC43	0
SC55	0
NC246	6.7
NC248	7.1
SC213	7.2
SC12	10.7
SC76	18.0
Coefficient of variation	101.1%
Least significant difference	N.S.
Mean percent	5.5

**Table 19.—Virus disease ratings on inbred lines of 1100-1200 maturity in Interregional Maize Inbred Evaluation test, August 26, 1981, Portsmouth, Ohio**

Inbred	Virus disease rating <sup>1/</sup>
T232	2.5
NC248	3.5
SC43	3.5
NC246	4.0
SC12	4.0
SC213	4.5
SC55	4.5
SC76	5.0
GT112RF	5.0
Coefficient of variation	25.3%
Least significant difference	N.S.
Mean rating	4.1

<sup>1</sup>Virus rated on a 1 to 9 scale with 1 = no symptoms and 9 = severe symptoms.

**Table 20.—Incidence of maize dwarf mosaic (MDM) in commercial and open-pedigree hybrids, August 11, 1981, Portsmouth, Ohio**

Hybrid	MDM-Percent
H101xOh91906	0 a <sup>1/</sup>
Robinson Exp. 5956	0 a
Southern States S.S.710	0 a
Oh79-1939xOh91619	0 a
Northrup King PX95	0 a
H95xOh79-8079	0 a
Oh79-8076xOh79-8077	0 a
Mo17HtxT232	.4 ab
Voris V2571	.4 ab
Robinson R3922	.4 ab
Oh79-1927xOh91619	.4 ab
Mo40xMp412	.8 ab
Migro Exp. 8050	.8 ab
Landmark C788XX	.8 ab
Kenworthy KL-X73A	1.2 ab
Robinson Exp. 5955	1.2 ab
H95x(Oh7BxOh07)	1.2 ab
Zimmerman Z32Y	1.2 ab
Zimmerman Z30Y	1.2 ab
Cargill 951	1.2 ab
Madison MDM1	1.2 ab
Stewart SX77M	1.2 ab
Landmark C787XX	1.2 ab
Zimmerman Z52W	1.6 ab
Pioneer brand 3147	1.6 ab
O's Gold 5255	1.6 ab
Northrup King PX79	1.9 ab
DeKalb XL72B	1.9 ab
Robinson Exp. 5954	2.0 ab
Zimmerman Z14W	2.0 ab
Ferry-Morse Exp. 4045	2.0 ab
Funk G-4525A	2.0 ab
Pioneer brand X7509	2.3 ab
P.A.G Exp. 284074	2.4 ab
Pioneer brand 3328	2.4 ab
Zimmerman Z11W	2.7 a-c
P-A-G SX17A	2.8 a-c
Pioneer brand 3179	2.8 a-c
Southern States S.S.950W	3.1 a-c
Kenworthy KL-X74	3.1 a-c
Funk G-4740	3.1 a-c
Taylor-Evans T-E6945	3.2 a-c
DeKalb XL61	3.6 a-d
Ruff's R-445	3.7 a-d
(Oh509AxOh514)xH95	4.0 a-d
Kenworthy KL-X73	4.0 a-d
Zimmerman Z24Y	4.3 a-d
(Oh7BxMo12) (CI.38BxVa35)	4.9 a-d
O's Gold 3344	5.2 a-d
Columbiana H-2745	5.4 a-d
DeKalb Exp. 018	6.0 a-d
Pioneer brand 3160	6.1 b-d
Zimmerman Z54W	8.4 c-e
Trojan brand MDM116	9.2 de
Northrup King X6701	13.2 e
Trojan brand TX119A	20.8 f
DeKalb Exp. 011	36.5 g
WF9xOh51A	91.6 h
Coefficient of variation	70.4%
Least significant difference	4.9
Mean percent	4.9

<sup>1</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 21.—Incidence of maize chlorotic dwarf (MCD) in commercial and open-pedigree hybrids, August 11, 1981, Portsmouth, Ohio**

Hybrid	MCD-Percent
H101xOh91906	0 a <sup>1/</sup>
Southern States S.S.710	0 a
Migro Exp. 8050	0 a
Zimmerman Z30Y	0 a
Oh79-1939xOh91619	.4 ab
Mo40xMp412	.4 ab
Oh79-8076xOh79-8077	.4 ab
(Oh509AxOh514)xH95	.4 ab
Robinson Exp. 5956	.4 ab
Voris V2571	.8 a-c
Pioneer brand 3179	1.2 a-d
H95xOh79-8079	1.2 a-d
Cargill 951	1.2 a-d
Stewart SX77M	1.2 a-d
Landmark C787XX	1.3 a-d
Landmark C788XX	1.6 a-e
P-A-G SX17A	1.6 a-e
Funk G-4525A	1.6 a-e
Trojan brand MDM116	1.8 a-e
Pioneer brand X7509	2.0 a-e
Madison MDM1	2.3 a-e
Southern States S.S.950W	2.3 a-e
H95x(Oh7BxOh07)	2.3 a-e
Pioneer brand 3160	2.4 a-e
Robinson Exp. 5955	2.7 a-e
Taylor-Evans T-E6945	2.8 a-e
Oh79-1927xOh91619	2.9 a-e
Pioneer brand 3328	3.2 a-e
DeKalb Exp. 018	3.2 a-e
DeKalb XL61	3.3 a-e
Ferry-Morse Exp. 4045	3.3 a-e
Columbiana H-2745	3.4 a-e
Zimmerman Z52W	3.5 a-e
Mo17HtxT232	3.5 a-e
DeKalb Exp. 011	3.5 a-e
Robinson Exp. 5954	3.6 a-e
Zimmerman Z32Y	3.6 a-e
DeKalb XL72B	3.9 a-f
Trojan brand TX119A	4.0 a-f
Robinson R3922	4.4 a-f
Kenworthy KL-X73	4.4 a-f
O's Gold 5255	5.1 a-f
Kenworthy KL-X74	5.8 a-f
P-A-G Exp. 284074	5.8 a-f
O's Gold 3344	6.3 a-f
WF9xOh51A	6.4 a-f
Zimmerman Z24Y	6.6 a-f
Zimmerman Z11W	6.8 a-f
Kenworthy KL-X73A	6.9 a-f
Northrup King PX79	7.6 a-f
Northrup King X6701	7.8 b-f
Funk G-4740	7.9 b-f
Northrup King PX95	8.5 c-f
Zimmerman Z14W	8.9 d-f
Pioneer brand 3147	9.1 ef
Ruff's R-445	9.2 ef
Zimmerman Z54W	11.6 e
(Oh7BxMo12) (CI.38BxVa35)	18.5 f
Coefficient of variation	115.5%
Least significant difference	6.3
Mean percent	3.9

<sup>1</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

**Table 22.—Virus disease ratings on commercial and open-pedigree hybrids, August 25, 1981, Portsmouth, Ohio**

Hybrid	Virus disease rating <sup>1/</sup>
H101xOh91906	1.0 a <sup>2/</sup>
Madison MDM1	1.0 a
Southern States S.S.710	1.0 a
Oh79-1939xOh91619	1.0 a
Migro Exp. 8050	1.0 a
Zimmerman Z30Y	1.0 a
Oh79-8076xOh79-8077	1.0 a
Robinson Exp. 5956	1.0 a
Mo40xMp412	1.0 a
Voris V2571	1.0 a
H95xOh79-8079	1.1 ab
Landmark C788XX	1.3 a-c
Stewart SX77M	1.5 a-c
Cargill 951	1.5 a-c
Landmark C787XX	1.5 a-c
Mo17JtxT232	1.8 a-d
Pioneer brand X7509	1.8 a-d
Pioneer brand 3179	1.8 a-d
Zimmerman Z32Y	1.9 a-d
Zimmerman Z52W	2.0 a-d
Oh79-1927xOh91619	2.0 a-d
Ferry-Morse Exp. 4045	2.0 a-d
P-A-G SX17A	2.0 a-d
Funk G-4525A	2.0 a-d
H95x(Oh7BxOh07)	2.0 a-d
(Oh509AxOh514)xH95	2.0 a-d
Robinson Exp. 5954	2.1 a-e
Robinson R3922	2.1 a-e
Pioneer brand 3147	2.1 a-e
Robinson Exp. 5955	2.3 a-e
Kenworthy KL-X73A	2.3 a-e
Pioneer brand 3328	2.4 a-f
Southern States S.S.950W	2.4 a-f
Ruff's R-445	2.5 a-g
DeKalb XL72B	2.5 a-g
Trojan brand MDM116	2.5 a-g
Taylor-Evans T-E6945	2.6 a-h
Northrup King PX79	2.6 a-h
DeKalb XL61	2.6 a-h
Pioneer brand 3160	2.8 a-h
Kenworthy KL-X73	2.8 a-h
P-A-G Exp. 284074	2.9 a-h
O's Gold 5255	2.9 a-h
DeKalb Exp. 018	3.0 b-h
Zimmerman Z24Y	3.0 b-h
Columbiana H-2745	3.0 b-h
Funk G-4740	3.1 c-h
Zimmerman Z11W	3.1 c-h
Kenworthy KL-X74	3.1 c-h
O's Gold 3344	3.5 d-h
Northrup King PX95	3.5 d-h
Zimmerman Z14W	4.0 e-h
Trojan brand TX119A	4.3 f-i
Zimmerman Z54W	4.4 g-i
DeKalb Exp. 011	4.5 hi
(Oh7BxMo12) (CI.38BxVa35)	4.5 hi
Northrup King X6701	4.5 hi
WF9xOh51A	6.0 i
Coefficient of variation	26.5%
Least significant difference	1.5
Mean rating	2.4

<sup>1</sup> Virus disease rated on a 1 to 9 scale with 1 = no symptoms and 9 = severe symptoms.

<sup>2</sup> Duncan's New Multiple Range Test—Entries with the same letter in common are not considered significantly different at the 5 percent level.

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